

Update on the SAM and the Box Test



Tyler Ley

Outline

1. Super Air Meter
2. The Box Test

digital gauge



different bleeder valve



Six clamps!

AASHTO Test Method

- The SAM is now an AASHTO provisional test method!
- AASHTO TP 118
- Thanks to the help of Larry Sutter of Michigan Tech, Mic Syslo, and Wally Heyen of Nebraska Department of Roads

Controlled Air Pressure Extender aka CAPE



Compressed
air

Step 3
(45 psi)

Step 2
(30 psi)

Step 1
(14.5 psi)

SAM modifications

- The SAM can be completed in 8-10 minutes with the air pump
- If you use the CAPE then it can be completed in 4-6 minutes
- An all metal body gauge is under development

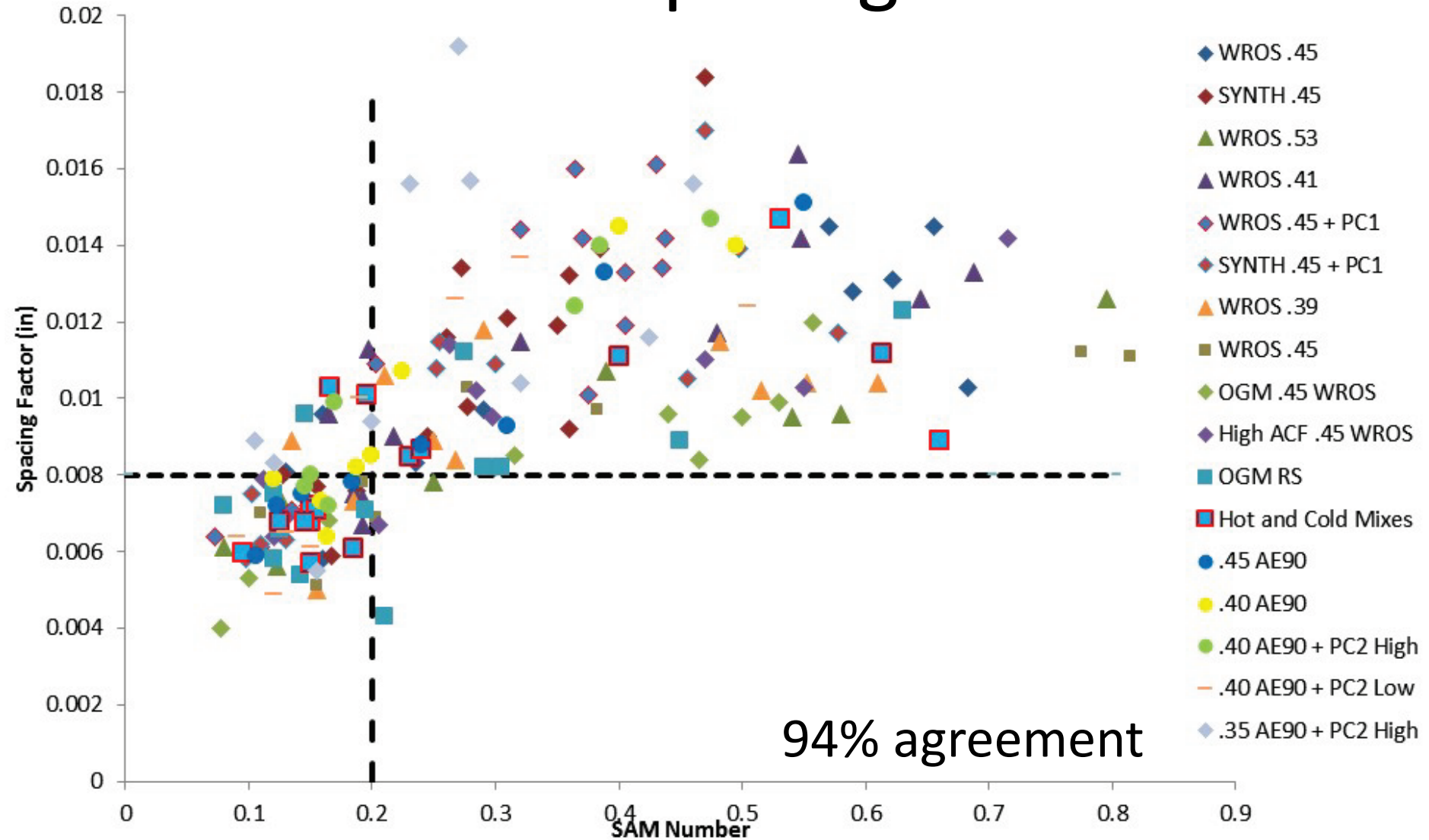
The following states have a SAM

- Michigan (5)
- Kansas (6)
- Utah
- Colorado (2)
- Iowa (2)
- Illinois (5)
- Indiana (2)
- Wisconsin (4)
- Massachusetts
- Idaho (2)
- Tennessee
- Pennsylvania
- Missouri (2)
- N. Carolina (3)
- N. Dakota
- Oklahoma (9)
- Nebraska (3)
- Ohio (3)
- Minnesota (2)
- Texas (2)
- FHWA (4)
- Georgia
- New Jersey
- New York
- South Dakota
- Mississippi
- Iowa (2)
- Manitoba (3)
- Ontario (2)

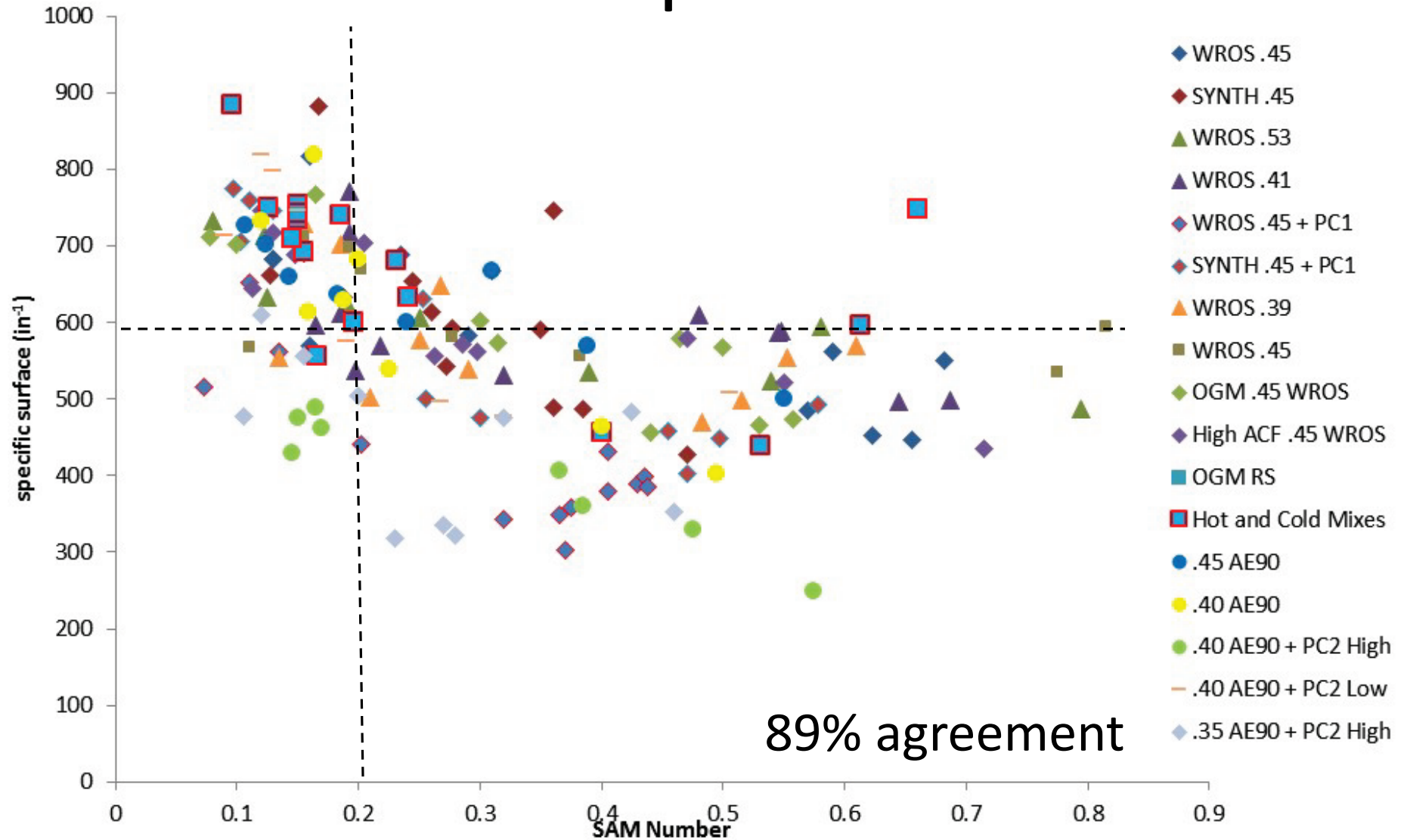
What have we done in the lab?

- Completed 220 laboratory testing for typical pavement and bridge deck concrete
- Investigated w/cm from 0.35 to 0.53
- Different AEsAs, admixture combinations, with and without fly ash, different temperatures

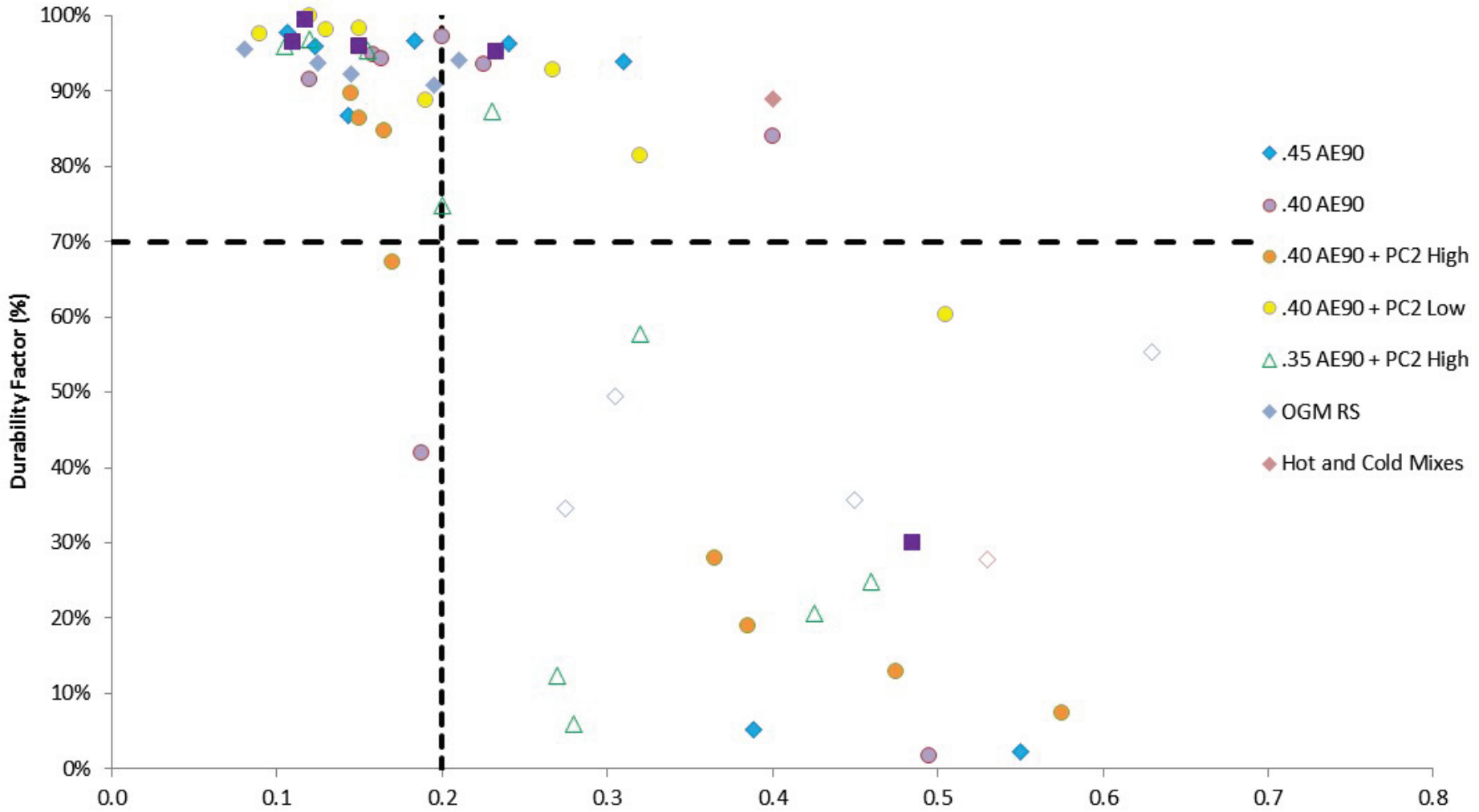
SAM vs spacing factor



SAM vs specific surface

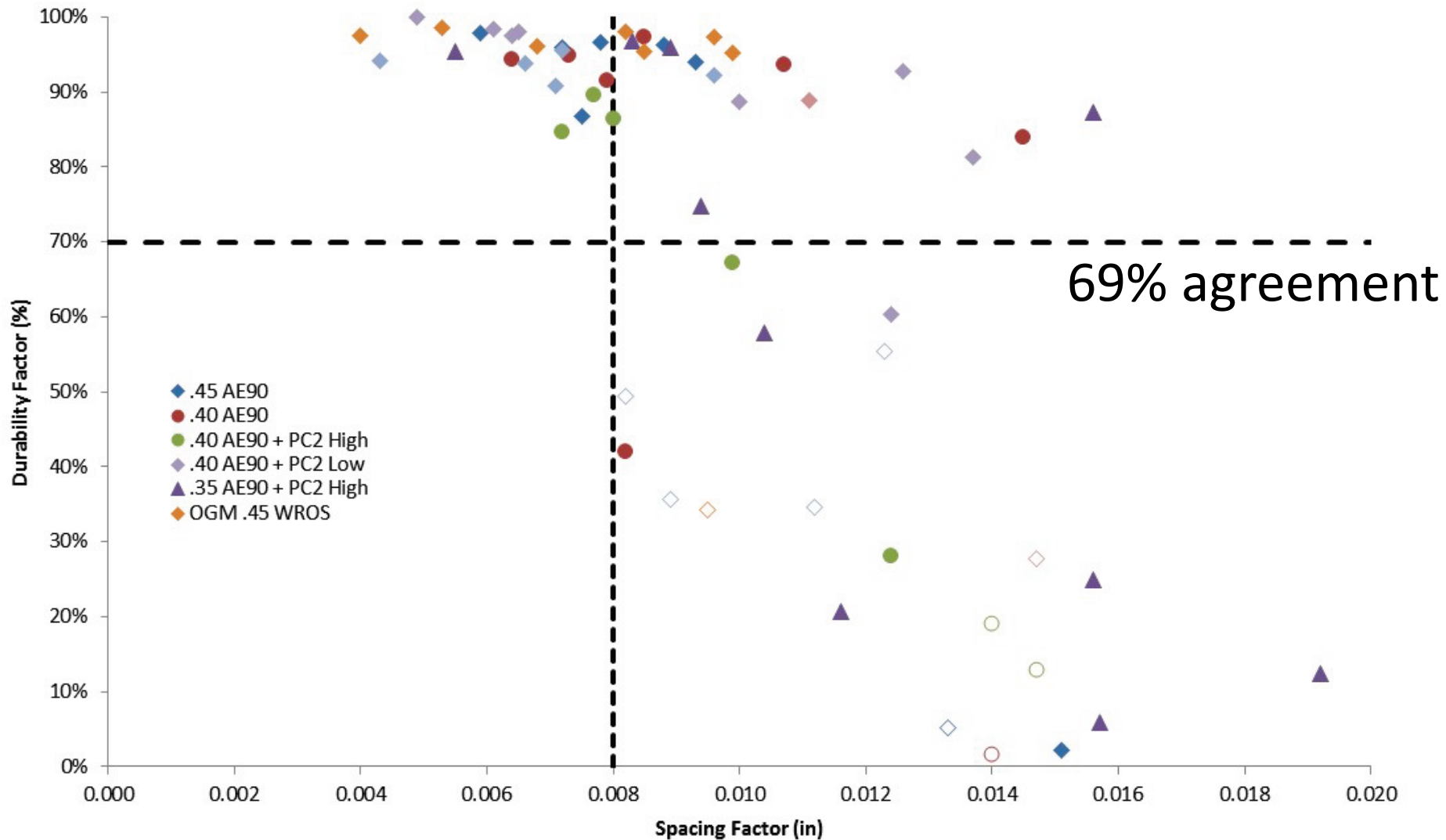


SAM vs rapid freeze thaw



80% agreement w/ 0.20 limit
89% agreement w/ 0.25 limit

Spacing factor vs rapid freeze thaw



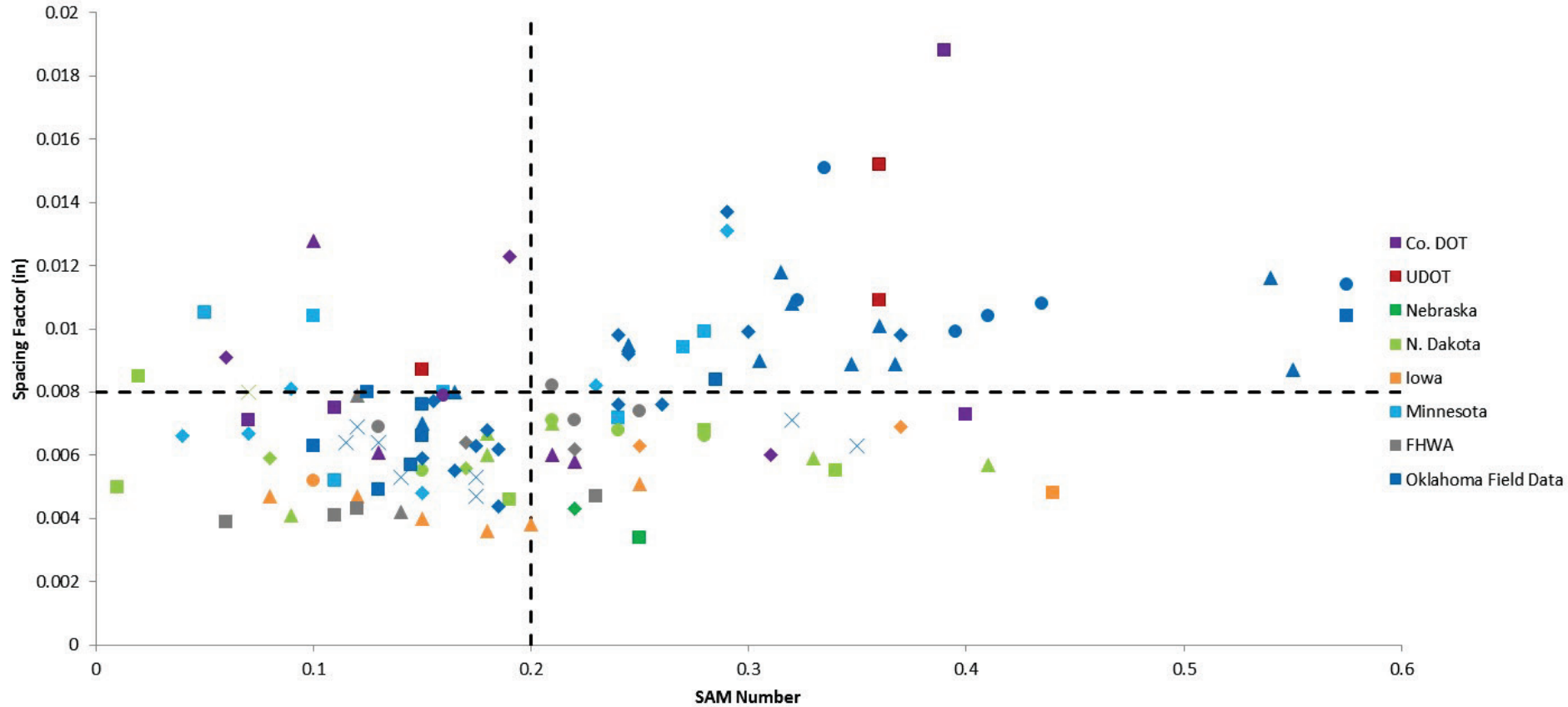
Discussion

- A SAM number of 0.20 shows 94% agreement with laboratory spacing factor limit of 0.008”
- The same limit shows 89% agreement with specific surface limit of 600 in⁻¹
- For the freeze thaw data there is better agreement for a SAM number of 0.25 (89%) than for a SAM number of 0.20 (80%)
- The SAM number had a better correlation with freeze thaw results than the spacing factor

What have we done in the field?

- Visited eight field sites in Oklahoma and sampled 60 different mixtures
- Gathered 90 field mixtures from Colorado, Utah, Nebraska, Minnesota, N. Dakota, Iowa, FHWA
 - 30% bridges, 67% pavements, 3% other
- We have another 50 mixes from Michigan and FHWA mobile concrete lab that will be added soon

SAM vs spacing factor



70% agreement w/ 0.20 limit
84% agreement w/ 0.25 limit

Discussion

- A SAM limit of 0.25 shows 84% agreement while the SAM limit of 0.20 shows 70% agreement
- The field data is more variable than the lab data

How do we choose a SAM limit?

- We run fresh and hardened air tests as a surrogate for freeze thaw durability.
- This suggests that we should choose a SAM limit based on the freeze thaw testing
- While a SAM limit of 0.25 may be a better predictor of freeze thaw performance, a limit of 0.20 is conservative.
- Maybe we use the 0.20 as an accept limit and the 0.25 as an action limit?

Proposed SAM limit

- If SAM number is less than 0.20 then accept the concrete
- If SAM number is between 0.20 and 0.25 then request the air be increased on the next load
- If the SAM number is greater than 0.25 then there is concern about freeze thaw durability
- Total air content must be above 5%

How can this group help?

- Get a SAM and start using it
- **Share your data and send a cylinder and we will do hardened air-void analysis**
- We will make all of the data public
- If you have already promised me data then provide it!

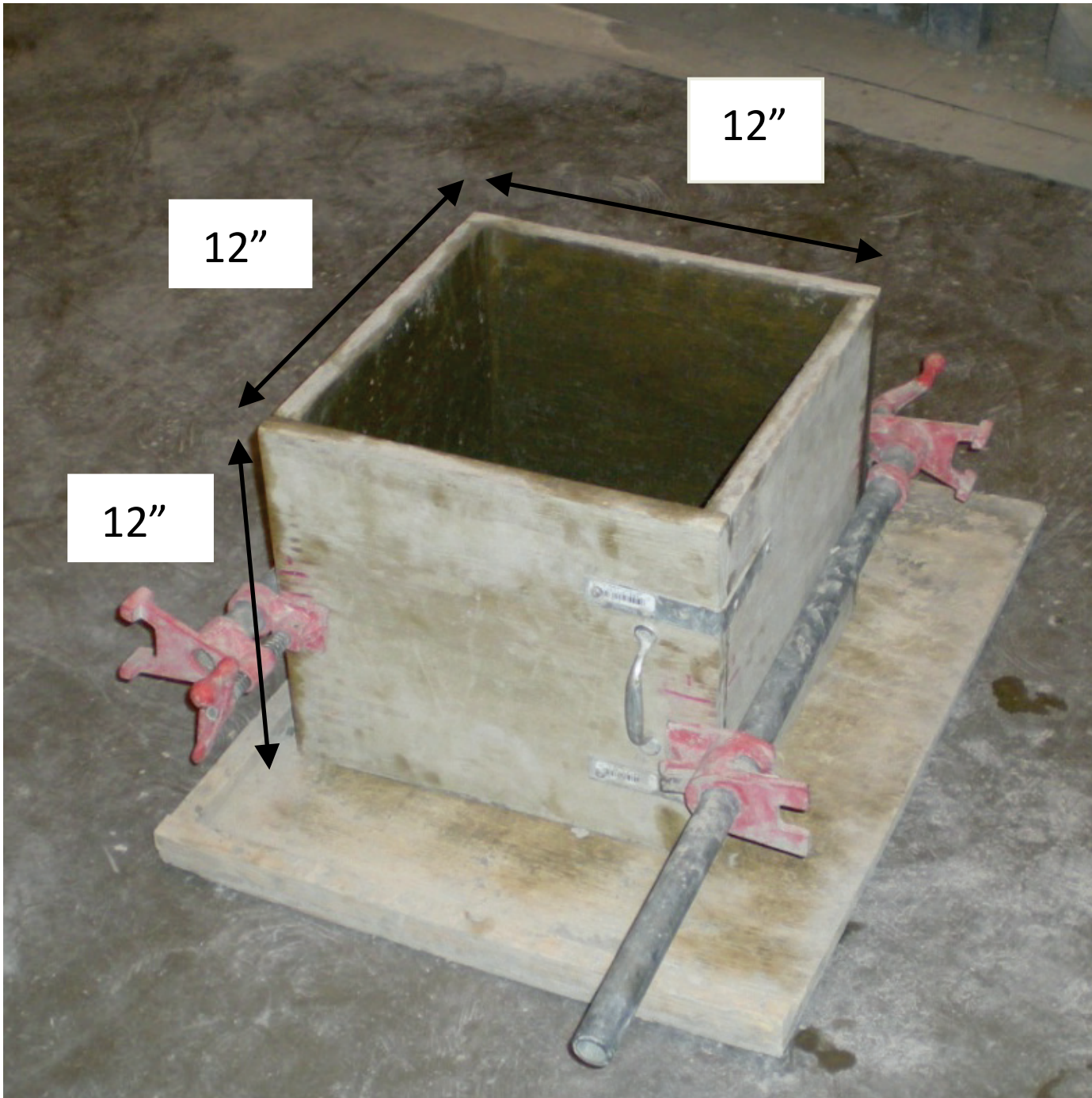
www.superairmeter.com

Other Work

- We are holding a SAM robin at Oklahoma State this winter.
- All experienced SAM users are invited!
- We will check calibration of meters and have operators pass a proficiency exam
- We will have ready mix concrete brought into our lab and everyone will sample at the same time.

The Box Test

- A simple test that examines:
 - Response to vibration
 - Filling ability of the grout (avoid internal voids)
 - Ability of the slip formed concrete to hold a sharp edge (cohesiveness)
- **The slump test can not tell us this!**



Box Test

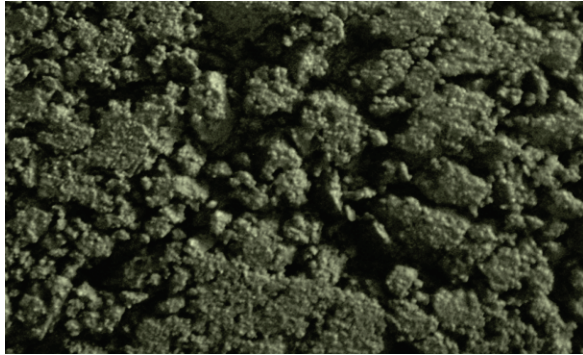
- Add 9.5” of unconsolidated concrete to the box
- A 1” diameter stinger vibrator is inserted into the center of the box over a three count and then removed over a three count
- The edges of the box are then removed and inspected for honey combing or edge slumping





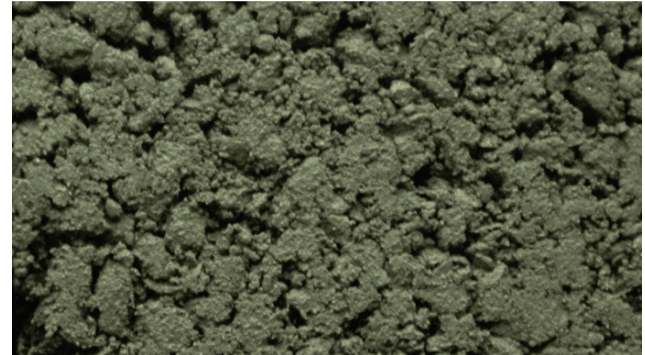


Box Test Ranking Scale



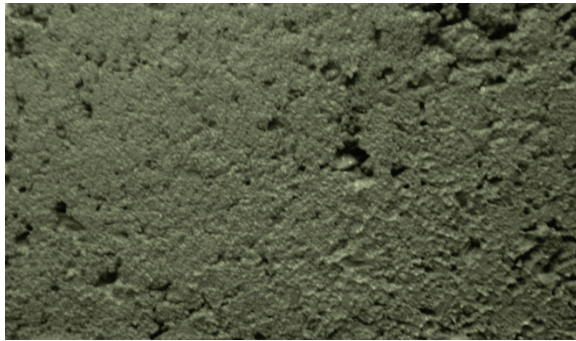
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Over 50% overall surface voids.



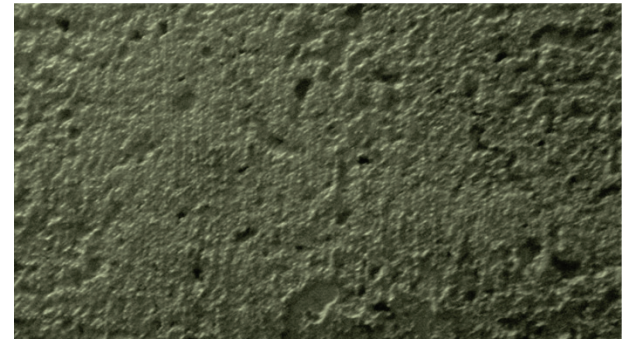
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30-50% overall surface voids.



2

10-30% overall surface voids.

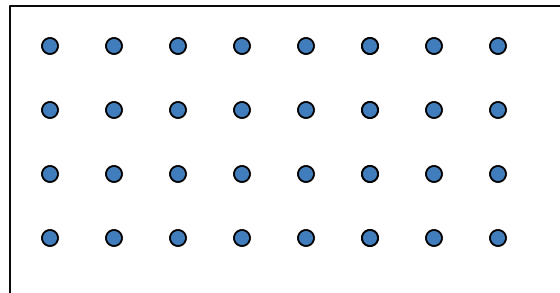


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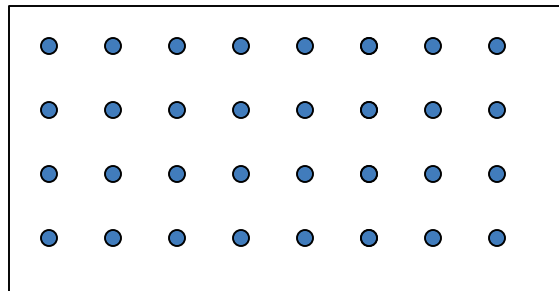
Less than 10% overall surface voids.

Visual Ranking

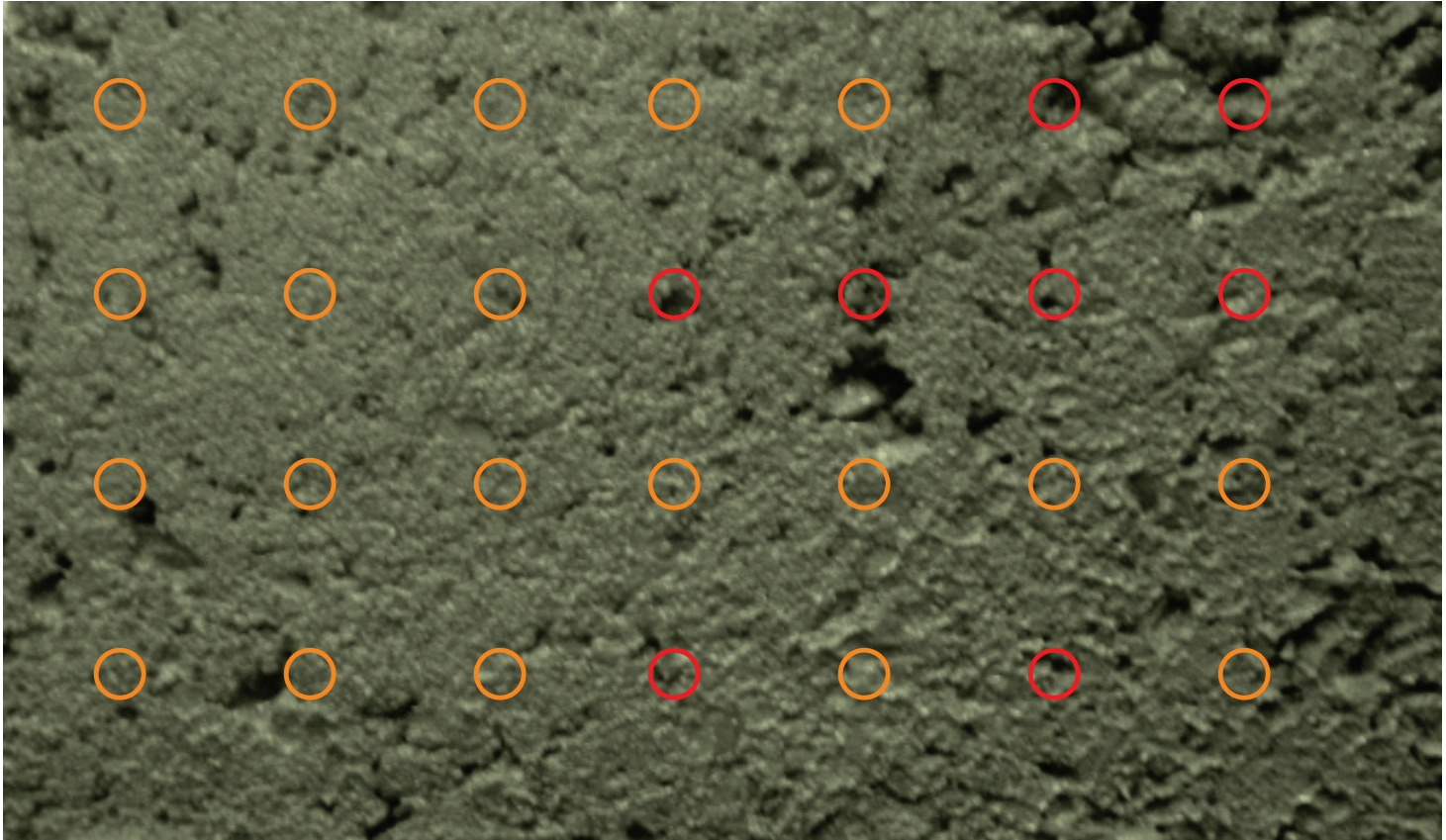
- Instead of just eyeballing the amount of surface voids we have started using a more systematic procedure.
- You use plexi glass with circles printed on it and hold it up to the surface and examine each circle to see if there is a void.



- By counting the dots where there are voids then you can quickly estimate the amount of surface voids.
- This is like doing a point count on a hardened air sample.
- We are still perfecting the technique.



Red circles = void
Orange circles = mortar



28 dots total
8 dots with voids
 $8/28 = 28\%$ voids

This takes about 30
seconds per side

www.optimizedgraded.com

What's Next?

- Finalize the details of the point count to estimate the surface voids
- Eleven states have been given a Box Test and vibrators to try out
- We have a new YouTube video on how to run the box test.
- Develop an AASHTO Provisional Test Method!!!!

www.optimizedgraded.com

Questions???

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May the Force be
with you!!!!